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(54) Title: CENTRAL LUBRICATING UNIT

FIG 1

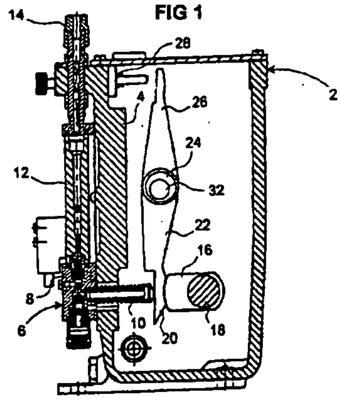
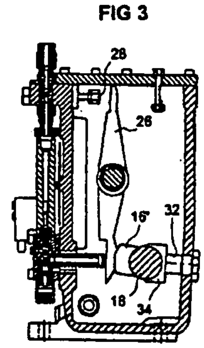


FIG 3



(57) **Abstract:** There is disclosed a central lubricating apparatus. It has a housing (2) with a row of piston pump units (6). Fig. 1 illustrates a prior art apparatus and Fig. 3 illustrates a new apparatus. It appears that the new apparatus is provided with one or more bearing liners (34) which via adjustable bolts (32) supports a rotatable shaft (18) upon which there is provided actuating cams (16) acting on a thrust pad (20) activating the piston (10) of the piston pump unit. As the thrust pad (20) and the actuating cams (16') are hardened, and as the shaft (18) is supported by the bearing liners (34), it is possible to utilise a known housing with very few modifications in order thereby to enable central lubrication via pressurised atomising nozzles having a pressure that may be about 10 times greater than traditional injection or pump pressure which is used and injected according to traditional principles. With the new centrallubricating apparatus it is thus possible to use pres- sure up to 100 bar or more, fat more than the performance of prior art lubricating apparatuses.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Central Lubricating unit.

Background of the Invention

The present invention concerns a central lubricating apparatus for lubricating engine cylinders in large diesel engines, particularly marine engines, by oil injection and made with a compact pump unit comprising a row of piston pumps driven by a common rotating shaft which is provided with driving cams interacting with thrust pads for respective axially displaceable spring-loaded pistons in the row of piston pumps.

These lubricating apparatuses are traditionally made as compact pump units which are mounted in close connection to their respective cylinders, and which are pipe connected to a feed reservoir of lubricating oil and to plural oil injection nozzles on different parts of the cylinder wall. Each unit has a row of piston pumps operating the different lubricating points, being driven by a common rotating shaft with cams fitted thereon, which by the rotation of the shaft in a housing for the apparatus interact with thrust pads on respective axially displaceable pistons which are spring-loaded in direction towards the shaft so that the pistons will perform reciprocating movements by rotation of the shaft for activating respective piston pumps of which the pistons form a part.

In principle, these lubricating apparatuses have operated impeccably according to the same principle for many years where they have operated under the condition that the discharge pressure from the piston pumps was not required to be very large, as it is a permanent rule that the oil is to be injected into the cylinder during the upward return stroke of the engine piston, i.e. during the compression movement, though before the subsequent working stroke at the ignited combustion. Hereby, it has been of immediate interest to work with injection or pump pressures of the magnitude 10 bar.

Within later years, cf. WO 00/28194, it has been proposed to make the lubrication efficient by injecting the oil through pressurised atomising nozzles for achieving oil mist lubrication, and even if this may occur continuously during the upward movement of the piston, the oil has to be supplied at a far higher pressure for ensuring fine

atomisation through ordinary, simple atomising nozzles, e.g. a pressure up to 100 bar or more. This is far more than the ability of prior art lubricating apparatus constructions, and therefore entirely new pump constructions have been considered.

However, by the invention it has surprisingly appeared that it is actually possible to make use of prior art constructions when these are modified on at least one of two essential points, namely partly by a sliding, fixed support of the said shaft against the rear wall of the housing of the apparatus, and partly by making the said drive cams and their interacting part in a hardened version. On a more detailed level is added that it is also required to made the shaft somewhat stronger than hithertofore and to fasten the cams even better to the shaft.

According to the invention, the central lubricating apparatus is peculiar in that the lubricating apparatus is connected with pressurised atomising nozzles for the oil injection, that the shaft is supported along its length by one or more bearing liners disposed diametrically opposite to the axially displaceable pistons, that the drive cams and the interacting thrust pads are made at least with hardened surfaces, and that the bearing liners are mounted on a rear wall in the pump unit by using a bolt enabling adjustment of the position of the bearing liner.

Hereby it has been realised that on the other hand it is possible to maintain the lubricating apparatuses largely in their present embodiment, which of course will be an appreciable advantage. The provision of direct support of a stronger dimensioned shaft will ensure the necessary transmission of a well-defined high pressure for the piston pumps, and the hardened engaging parts will ensure good wear resistance of their interacting wearing surfaces.

Concerning the wear resistance it is to be mentioned that by the prior art lubricating apparatuses, an appreciable wear on the actuating cams and the pistons interacting therewith or thrust pads for these has been accepted, since this only has resulted in a small change in the oil volume discharged per pump stroke. The situation is different with regard to the invention because here it is an essential function to dose the oil at

the required high atomising pressure, whereas not atomised oil will be utilised very inefficiently.

By experiments it has been ascertained that even a moderate wear on the said parts during high pressure operation has decisive negative influence on the quality of the atomisation of the oil, and by use of an unchanged pump concept reasons have been found for noting that the operational front and rear edges on the actuating cams are particularly subjected to the strongest wear action. This implies that the cams initiate and terminate the piston movements with continuously more damped movements, thereby influencing the time during which the oil at the nozzles are under sufficient pressure for efficient atomisation of the oil.

By the invention it is therefore particularly important to make the said cam edges extra wear resisting; this is found sufficiently achievable already at the said general use of hardened steel, but it will be within the scope of the invention to arrange other forms of special reinforcing of just the cam areas concerned.

On this background, by the invention it will even be a possibility that already existing lubricating apparatuses can be modified to the desired high pressure operation in a relatively simple way without any basic restructuring.

Description of the Drawing

The invention is explained in more detail below with reference to the drawing on which:

Fig. 1 is a sectional view of a conventional lubricating apparatus of relevant kind,

Fig. 2 is a longitudinal section thereof,

Fig. 3 is a view of a lubricating apparatus according to the invention corresponding to Fig. 1, and

Fig. 4 is a partial view of a cam arrangement in the apparatus according to the invention.

The apparatus shown in Figs. 1 and 2 has a box-shaped housing 2, which at a front wall 4 carries a row of piston pump units 6, of which only one is shown in Fig. 1. The unit has a valve housing 8 with a lower inlet for lubricating oil, an intermediate section for accommodating a piston 10 projecting into the housing 2, and an upper outlet for the piston pump thus formed. Via a flow indicator 12, the outlet is connected to an upper connecting stub 14, and from the entire row of these stubs connecting pipes extend to the lubricating points on the associated engine cylinder, e.g. in a number of 6 – 24.

The pistons 10 are operated for impression by means of actuating cams 16 on a through-going control shaft 18 which is rotated synchronously with the crankshaft of the engine. The pistons are not actuated directly but via thrust pads 20 on respective rocker arms 22, which are pivoting about a fixed axle 24 and have upwardly projecting extensions 26 interacting at the top with respective set screws 28 projecting inwardly from the front wall. The pistons 10 are spring-loaded in direction inwards against the thrust pads 20 which they will thus keep pressed inwards until respective upper arm ends abut on the set screws 28. Hereby, for each pump unit the initial position will be determined from which each of the thrust pads 20 will be pressed outwards at the passage of the associated actuating cam 16. In operation, in the shown situation there should be a certain distance between the arm part 26 and the set screw 28, so that the thrust pad 20 during the cam passage will be pressed outwards for operating the piston 10 and will go back to the said initial position after this passage under the action of the spring force of the piston. The set screws can hereby be operated for determining individual operational strokes of the pistons and thereby the associated performance of the individual pump units.

Above is indicated that the actuating cams 16 are drawing special attention in connection with the invention, and therefore it is to be mentioned the cams are conventionally made just as shown in Fig. 1, namely as pieces of flat bars which close to one end are formed with a bored hole for mounting on the control shaft 18. After boring the hole, the hole edge is reamed and subsequently finished for careful adapting to the shaft whereby the cam body is fastened in a simple way by means of a pin.

As shown in Fig. 2, the control shaft 18 is suspended in bearing casings 30 in the end walls of the housing 2, whereas the fixed axle 24 is suspended in the same walls by means of eccentrically disposed end pins 32, enabling a certain displacing of the axle 24 with the intention of desirable adjustments which, however, are not particularly relevant for the invention.

As already mentioned, by the invention one is confronted with the problem that a far greater pump pressure is required than hitherto common, and that the conventional pumps in view have appeared to be unsuited for this purpose. In connection with the invention many considerations have been made concerning more suited constructions until, surprisingly, it has been found that the conventional basic construction really will be usable by a combination of relatively simple modifications, namely optimally as follows:

a) The control shaft 18 is made with a slightly increased diameter in adapted bearing housings 30 so that the twist of the shaft under increased load may be kept at an acceptable level.

b) Both the actuating cams 16 and the rocker arms 22,20 are made in a hardened version for increasing their wear resistance.

c) The control shaft 18 is stabilised in its transverse direction by arranging a stationary rear support for this shaft 18 in one or some of the interspaces between the cams 16 with press connection to the rear wall of the housing; and

d) The actuating cams 16 are fastened in a modified way to the shaft 18.

Re a): This is based on a choice of the skilled in the art, which will be adjusted to the prevailing conditions, i.e. special dimensioning prerequisites are difficult to make here. However, for a slight adaptation it may be essential that, in spite of an increased diameter, the shaft 18 may still be accommodated in bearing housings 30 with unchanged outer diameter so that the housing construction does not necessarily have to be changed.

Re b): The changed pressure conditions result in far stronger mechanical actions in the pump system, however, by the invention it has been found that this system can be kept

largely unchanged when the parts discussed here are made in a hardened version as a combination feature in connection with the other modifications. The highly increased wear action will only occur between the actuating cams and the rocker arms, and surprisingly it has been found that the conventional construction may very well be maintained if only hardened wear parts are used.

Re c): Increasing the diameter of the control shaft 18, cf. point a), is essential for counteracting twist of the shaft above an acceptable level, but another essential parameter is the bending stiffness of the shaft, as the operational stroke of the piston pumps will be much influenced directly by the control shaft itself yielding outwards under the strong counterpressure exerted by the pistons via the rocker arms and the actuating cams. A shaft stiffness needed therefore would require a considerably increased shaft diameter, not to say a completely different apparatus construction, but here it is found fully acceptable that the conventional system is maintained, namely when, as shown in Fig. 3, a suitable number of rear supports are added for sliding support of the shaft towards the rear wall of the housing. In the shown example, we are speaking of short support rods or bolts 32, which abut on the shaft 18 with a bearing liner 34. In smaller apparatuses it may be sufficient to dispose a single such rear support at the centre of the shaft, but otherwise several such may very well be provided.

Re d): The already mentioned, known way of fastening the actuating cams is unsuitable for use in connection with hardened cams but it has been found quite safe to use another, in some ways simpler, arrangement, namely as shown in Fig. 4: The cams 16 are made with a peripheral dimension which is slightly less than the thickness of the shaft 18, and they are made with a bolt hole 36 at the centre and a couple of pinholes 38 close to the sides, possibly a little mutually staggered in the longitudinal direction of the shaft. Corresponding holes are bored into the shaft, and then a very good attachment of the cam may be achieved by inserting pins in the holes 38 and by countersunk screwing of a bolt into the hole 36. However, possibly two or more screws may be used instead.

The invention will primarily comprise the simultaneous use of the indicated modifications, but there may be border cases where e.g. three of the modifications may be sufficient.

As a possible alternative to the said fastening of the cams 16 there may be used a basic item which is profiled as cams and shaft together. The run surfaces for the said supports and for the bearing surfaces in the bearing housings 30 and the shaft ends may then be formed by turning into cylindric shape.

CLAIMS

1. A central lubricating apparatus for lubricating engine cylinders in large diesel engines, particularly marine engines, by oil injection and made with a compact pump unit comprising a row of piston pumps driven by a common rotating shaft which is provided with driving cams interacting with thrust pads for respective axially displaceable spring-loaded pistons in the row of piston pumps, **characterised** in that the lubricating apparatus is connected with pressurised atomising nozzles for the oil injection, that the shaft is supported along its length by one or more bearing liners disposed diametrically opposite to the axially displaceable pistons, that the drive cams and the interacting thrust pads are made at least with hardened surfaces, and that the bearing liners are mounted on a rear wall in the pump unit by using a bolt enabling adjustment of the position of the bearing liner.

2. A central lubricating apparatus according to claim 1, **characterised** in that the drive cams actuate the pistons via thrust pads on respective rocker arms which are pivotable about a fixed axle in the pump unit.

3. A central lubricating apparatus according to claim 2, **characterised** in that each rocker arm has an extension extending at the opposite side of the fixed axle in relation to the thrust pad and which interacts with a respective set screw.

4. A central lubricating apparatus according to any preceding claim, **characterised** in that that the drive cams and the thrust pads are made of hardened steel.

5. A central lubricating apparatus according to any of claims 1 – 3, **characterised** in that the drive cams and the thrust pads are made of surface hardened steel.

6. A central lubricating apparatus according to any preceding claim, **characterised** in that the operational front and rear edges of the drive cams are particularly hardened, e.g. by special hardening of the surface in these areas.

7. A central lubricating apparatus according to any preceding claim, **characterised** in that the drive cams and the shaft are made as one suitably profiled item in which shaft ends and bearing surfaces are formed by turning into cylindrical shape.

8. A central lubricating apparatus according to any of claims 1 – 6, **characterised** in that the drive cams are separate elements, which are connected with the shaft by means of dowel pins mounted in pin holes in the shaft and the cams, and which are fastened to the shaft by means of one or more screws.

9. A central lubricating apparatus according to claim 8, **characterised** in that the dowel pins are provided in the areas at the sides of the cam and are arranged staggered in the longitudinal direction of the shaft.

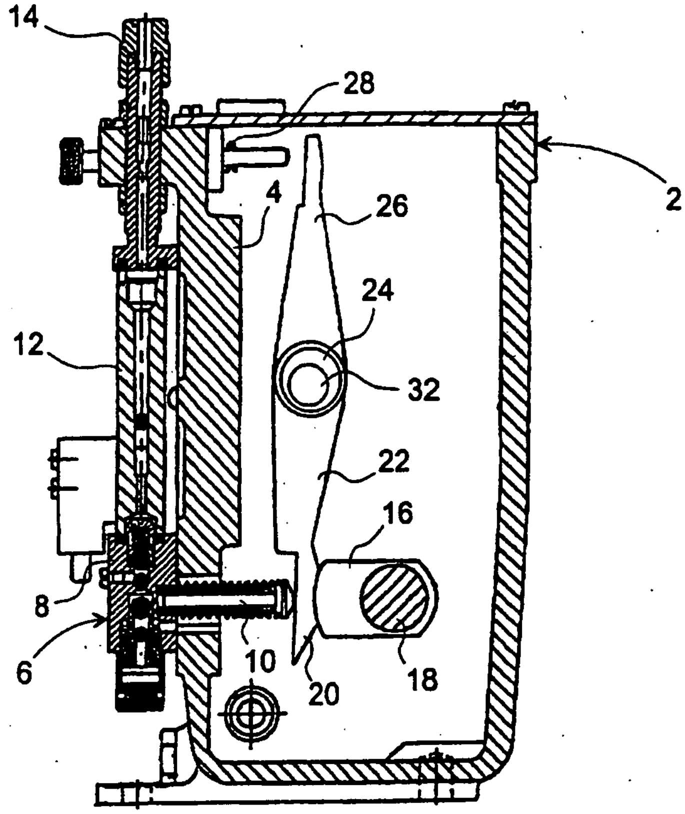

Fig.1

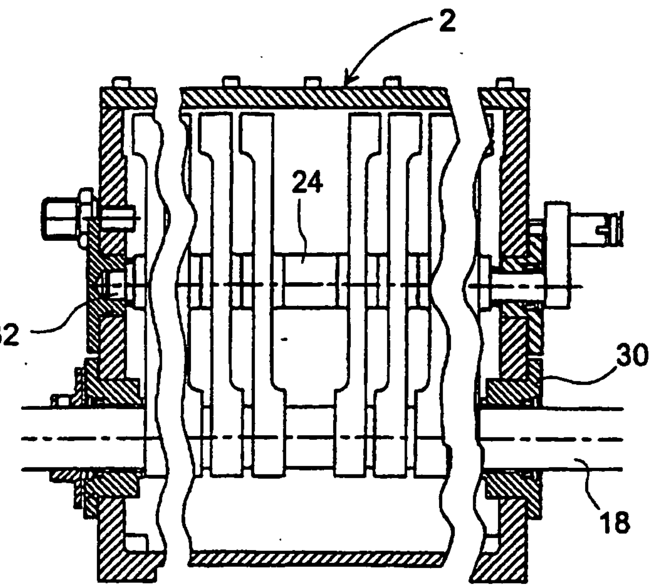

Fig.2

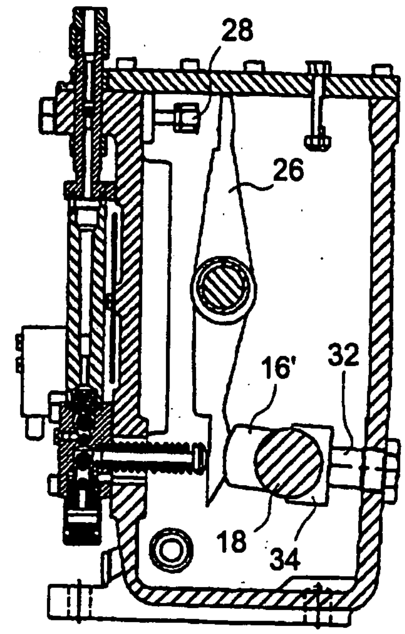

Fig.3

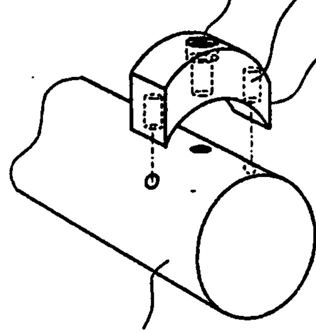

Fig.4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/DK 02/00356

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: F01M 1/02, F01M 1/08, F01M 1/16, F01M 3/04 // F16N 13/04
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: F01M, F16N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 3637031 A1 (HANS JENSENS MASKINFABRIK A/S), 7 May 1987 (07.05.87), figure 2 --	1-9
A	WO 9609492 A1 (HANS JENSENS MASKINFABRIK A/S), 28 March 1996 (28.03.96), figure 1 --	1-9
A	DE 3909772 A1 (MITSUBISHI JUKOGYO K.K), 12 October 1989 (12.10.89), figure 2 -- --------	1-9

☐ Further documents are listed in the continuation of Box C.   ☒ See patent family annex.

* Special categories of cited documents:

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"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 July 2002	29-07-2002
Name and mailing address of the ISA Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Jan-Axel Ylivainio/SN Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT
Information on patent family members

10/06/02

International application No.
PCT/DK 02/00356

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